CLAIMS

What is claimed is:

1.   A method for allocating communication channels for handoff in a first base station having a communication link with active mobile stations located in a handoff area of the first base station and a second base station, the method comprising:

    (a)   constructing a channel convertible set including communication channels for active mobile stations moving in a direction away from the first base station;

    (b)   receiving a handoff request from a requesting mobile station having a communication link with the second base station;

    (c)   determining whether a free channel is available for the handoff request; and

    (d)   if a free channel is not available for the handoff request, allocating one of the communication channels in the channel convertible set to the handoff request.

2.   The method of claim 1 wherein constructing a channel convertible set includes determining whether the active mobile stations are moving in a direction away from the first base station.

3.   The method of claim 2 wherein determining whether the active mobile stations are moving in a direction away from the first base station includes determining whether the signal strength of the communication link between the active mobile stations and first base station has decreased over a period of time.

4. The method of claim 2 wherein determining whether the active mobile stations are moving in a direction away from the first base station includes determining whether the signal strength of the communication link between the active mobile stations and second base station has increased over a period of time.

5. The method of claim 1 wherein the communication channels in the channel convertible set further includes communication channels for active mobile stations that are stationary with respect to the first base station.

6. The method of claim 5 wherein constructing the channel convertible set includes determining whether the signal strength of the communication link between the active mobile stations and first base station are substantially the same over a period of time.

7. The method of 5 wherein determining whether the active mobile stations are stationary includes determining whether the signal strength of the communication link between the active mobile stations and second base station are substantially the same over a period of time.

8. The method of claim 5 wherein the communication channels included in the channel convertible set are associated with mobile stations each having a second communication channel with the second base station, wherein the signal strength of the second communication channel is greater than the signal strength of the communication channel with the first base station.

9. The method of claim 1 wherein the communication channels included in the channel convertible set are associated with mobile stations requesting handoff to the second base station.

10. The method of claim 9 wherein the communication channels included in the channel convertible set are associated with mobile stations each having a second communication channel with the second base station, wherein the signal strength of the second communication channel is greater than the signal strength of the communication channel with the first base station.

11. The method of claim 1 wherein the communication channels included in the channel convertible set are associated with mobile stations each having a second communication channel with the second base station, wherein the signal strength of the second communication channel is greater than the signal strength of the communication channel with the first base station.

12. The method of claim 1 wherein a set of communication channels included in the channel convertible set are associated with mobile stations each having a communication channel with the second base station and the mobile stations move from a location wherein the signal strength of the communication channel with the first base station is greater than the communication channel with the second base station to a location wherein the signal strength of the communication channel with the second base station is greater than the communication channel with the first base station.

13.   The method of claim 1 wherein the first base station is operable in a Code Division Multiple Access communication system.

14.   The method of claim 1 wherein the handoff process is soft handoff.

15.   The method of claim 14 wherein the first base station has an initial number of soft guard channels reserved for mobile stations requesting a communication link in the handoff area.

16.   The method of claim 15 further comprising:

(a)   determining the number of communication channels in the channel convertible set; and

(b)   reducing the number of soft guard channels based on the number of communication channels in the channel convertible set.

17.   The method of claim 1 wherein allocating one of the communication channels in the channel convertible set includes:

(a)   determining whether the requesting mobile station is moving in a direction towards the first base station; and

(b)   if the requesting mobile station is moving in a direction towards the first base station, allocating a channel in the channel convertible set to the requesting mobile station.

18.   The method of claim 1 wherein allocating one of the communication channels in the channel convertible set includes:

(a)   determining whether the requesting mobile station is stationary with respect to the first base station; and

(b)   if the requesting mobile station is stationary with respect to the first base station, allocating a channel in the channel convertible set to the requesting mobile station.
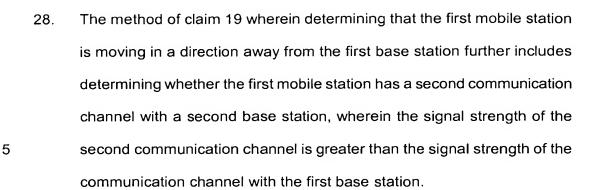
19.   A method for allocating a communication channel of a first base station from a first mobile station located in a handoff area and having an active communication link with the first base station to a second mobile station requesting handoff, the method comprising:

5   (a)   estimating the mobility of the first mobile station with respect to the first base station;

           (b)   receiving a handoff request from the second mobile station; and

           (c)   in response to determining that the first mobile station is moving in a direction away from the first base station, converting the

10   communication channel from the first mobile station to the second mobile station.

20.   The method of claim 19 wherein determining that the first mobile station is moving in a direction away from the first base station includes determining whether the signal strength of the active communication link

15   between the first mobile station and the base station has decreased over a period of time.

21.   The method of claim 20 wherein determining whether the first mobile station is moving in a direction away from the first base station includes determining whether the signal strength of the communication link

20   between the active mobile station and a second base station has increased over a period of time.

22.   The method of claim 19 wherein the communication channel is converted only in response to determining the first mobile station is stationary with respect to the first base station.

23. The method of claim 22 wherein determining the first mobile station is stationary with respect to the first base station includes determining whether the signal strength of the active communication link between the first mobile station and the first base station is substantially the same over a period of time.

24. The method of claim 22 wherein determining whether the first mobile station is stationary includes determining whether the signal strength of the communication link between the first mobile station and a second base station are substantially the same over a period of time.

25. The method of claim 22 wherein determining that the first mobile station is moving in a direction away from the first base station further includes determining whether the first mobile station has a second communication channel with a second base station, wherein the signal strength of the second communication channel is greater than the signal strength of the communication channel with the first base station.

26. The method of claim 19 wherein determining that the first mobile station is moving in a direction away from the first base station further includes determining whether the first mobile station is requesting handoff to a second base station.

27. The method of claim 26 wherein determining that the first mobile station is moving in a direction away from the first base station further includes determining whether the first mobile station has a second communication channel with the second base station, wherein the signal strength of the second communication channel is greater than the signal strength of the communication channel with the first base station.

28. The method of claim 19 wherein determining that the first mobile station is moving in a direction away from the first base station further includes determining whether the first mobile station has a second communication channel with a second base station, wherein the signal strength of the second communication channel is greater than the signal strength of the communication channel with the first base station.

29. The method of claim 19 wherein determining that the first mobile station is moving in a direction away from the first base station further includes determining whether the first mobile station has a communication channel with a second base station and the first mobile station moves from a location where the signal strength of a communication channel with the first base station is greater than the signal strength of a communication channel with a second base station to a location where the signal strength of the communication channel with the second base station is greater than the signal strength of the communication channel with the first base station.

30. The method of claim 19 wherein the first base station is operated in a Code Division Multiple Access communication system.

31. The method of claim 19 wherein converting the communication channel to the second mobile station includes:

    (a) determining whether the second mobile station is moving in a direction towards the first base station; and

    (b) if the second mobile station is moving in a direction towards the first base station, converting the communication channel from the first mobile station to the second mobile station.

32. A method for estimating the mobility of a mobile station with respect to a first base station, the method comprising:

    (a)   receiving a signal including an indication of signal strength between the first base station and the mobile station;

5   (b)   determining whether the signal strength changes over a period of time; and

    (c)   if the signal strength changes over the period of time, determining that the mobile station is moving in a direction with respect to the first base station.

10   33.   The method of claim 32 further comprising:

    (a)   determining whether the signal strength increases over a period of time; and

    (b)   if the signal strength increases over a period of time, reporting that the mobile station is moving in a direction towards the first base

15   station.

    34.   The method of claim 32 further comprising:

    (a)   receiving a second signal including an indication of signal strength between a second base station and the mobile station;

    (b)   determining whether the signal strength between the first base

20   station and the mobile station increases over a period of time;

    (c)   determining whether the signal strength between the second base station and the mobile station decreases over a period of time;

    (d)   if the signal strength between the first base station and the mobile station increases over a period of time and the signal strength

25   between the second base station and the mobile station decreases

over a period of time, reporting that the mobile station is moving in a direction towards the first base station.

35. The method of claim 32 further comprising;

    (a)   determining whether the signal strength decreases over a period of

5   time; and

    (b)   if the signal strength decreases over a period of time, reporting that the mobile station is moving in a direction away from the base station.

36. The method of claim 32 further comprising:

10   (a)   receiving a second signal including an indication of signal strength between a second base station and the mobile station;

    (b)   determining whether the signal strength between the first base station and the mobile station decreases over a period of time;

    (c)   determining whether the signal strength between the second base

15   station and the mobile station increases over a period of time;

    (d)   if the signal strength between the first base station and the mobile station decreases over a period of time and the signal strength between the second base station and the mobile station increases over a period of time, reporting that the mobile station is moving in

20   a direction away from the first base station.

37. The method of claim 32 further comprising;

    (a)   determining whether the signal strength remains substantially the same over a period of time; and

(b)   if the signal strength remains substantially the same over a period of time, reporting that the mobile station is stationary with respect to the base station.

38.   The method of claim 32 further comprising:

(a)   receiving a second signal including an indication of signal strength between a second base station and the mobile station;

(b)   determining whether the signal strength between the first base station and the mobile station remains substantially the same over a period of time;

(c)   determining whether the signal strength between the second base station and the mobile station remains substantially the same over a period of time; and

(d)   if the signal strength between the first base station and the mobile station remains substantially the same over a period of time and the signal strength between the second base station and the mobile station remains substantially the same over a period of time, reporting that the mobile station is stationary with respect to the first base station.

39.   A method for evaluating performance of a handoff scheme in a mobile communications network, the method comprising:

(a)   modeling calls arriving within a cell as a Poisson process with arrival rate λ_n;

(b)   modeling handoff call requests arriving within a cell as a Poisson process with arrival rate λ_h;

(c) modeling channel holding time using an exponential distribution with mean μ_c^{-1} ;

(d) generating a stochastic reward net model including a first station representing the normal area of a cell, a second station representing a set of calls without a channel convertible set, a third station representing a set of calls with a channel convertible set, and a fourth station representing a queue for handoff calls;

(e) applying Markovian analysis to the stochastic reward net to determine a handoff call dropping probability; and

(f) designing mobile communication handoff call resources based on the call handoff call and dropping probability.

40. A system for allocating communication channels in a mobile communications network, the system comprising:

(a) a mobility estimator for estimating the relative mobility of mobile stations with respect to a base station;

(b) a channel convertible set manager for generating a channel convertible set including communication channels for active mobile stations that are determined to be moving away from or stationary with respect to the base station based on mobility estimates generated by the mobility estimator; and

(c) a channel allocator for receiving requests for handoff calls and for allocating channels from the channel convertible set for the handoff calls.

41.   The system of claim 40 wherein the mobility estimator estimates the relative mobility of the mobile stations based on pilot strength measurement messages received from the mobile stations.

42.   The system of claim 41 wherein the mobility estimator determines that a mobile station is moving away from the base station when the pilot strength measurement messages indicate that pilot signal strength is decreasing over time.

43.   The system of claim 41 wherein the mobility estimator determines that a mobile station is stationary with respect to the base station when the pilot strength measurement messages indicate that pilot signal strength remains within a predetermined range within a period of time.

44.   The system of claim 40 wherein the channel convertible set manager adds communication channels to the channel convertible set based on the mobility estimates.

45.   The system of claim 40 wherein the channel allocator determines whether free channels are available for handoff calls and, in response to determining that no free channels are available, allocates a channel from the channel convertible set.

46.   The system of claim 40 wherein the channel allocator maintains a set of soft guard channels reserved for handoff requests and reduces the number of soft guard channels based on the number of channels in the channel convertible set.

47.   The system of claim 40 wherein elements (a) – (c) are located in a base station.

48.   The system of claim 40 wherein elements (a) – (c) are located in a mobile

        switching center.